REFERENCE 6

Scope of Work for Argonne-West Sanitary Sewage Treatment Expansion Facility No. 779 (various sections), Document No. W7790-0104-SA-00, 7/18/74

SPECIAL CONDITIONS

FOR

ARGONNE-WEST

SANITARY SEWAGE TREATMENT EXPANSION

FACILITY NO. 779

These Special Conditions shall apply to all divisions of these Specifications.

1. SCOPE OF WORK

The work covered by these Specifications includes, but is not necessarily limited to, the furnishing of all labor, supervision, material, plant, equipment, and services necessary to construct the expansion of the existing sewage treatment system and associated modifications and additions.

All work shall be in accordance with these specifications, the included drawings, and the applicable referenced standards.

The divisions of these Specificcations are as follows:

Section	Title
Division I	General Conditions
Division II	Special Conditions
Division III	Earthwork
Division IV	Roadwork & Paving
Division V	Concrete Work
Division VI	Fencing & Gates
Division VII	Culverts and Turnout Gates
Division VIII	Sewage Lagoon Liner
Division IX	Mechanical Work
Division X	Electrical Work

The following drawings accompany these Specifications and form a part of the contract documents:

ANL Drawing No. W7790-0103-DD-00, 4 sheets, dated June 3, 1974, entitled "Sanitary Sewage Treatment Expansion"

Sheet No.	Subtitle
1.	Plot Plans & Probe Hole Log
2.	Roadwork Plan & Sections
3.	Misc. Sections & Details
4.	Lagoon Details & Lift Station Work

2. LOCATION OF THE WORK

The construction work will be performed at the Experimental Breeder Reactor No. II (EBR-II) area of Argonne National Laboratory at the Argonne-West Site, National Reactor Testing Station, Idaho.

3. SECURITY REQUIREMENTS

Only persons meeting the security requirements of the United States Atomic Energy Commission shall be employed. The work will be performed in an unrestricted area; however, all employees of the Subcontractor and all Sub-subcontractors shall comply with all Laboratory and AEC requirements pertaining to badging, identification, and Health Physics. All persons visiting or performing work at the job site may be required to register at the Reception Building (Bldg. No. 751) upon entering or leaving, and access to the work area may be restricted as to routes and by conditions necessary for Laboratory operations.

4. SANITARY FACILITIES

The Subcontractor's personnel will be limited to use of sanitary facilities available at Plant Services Building, Building 753, at the Argonne-West Site.

5. SCHEDULING AND COORDINATION OF WORK

The Subcontractor shall notify the Laboratory at least two (2) days in advance of starting actual field construction work.

The work is to be performed in an area where normal Laboratory operations may be performed as this work progresses. The Subcontractor shall work in close cooperation and shall coordinate his activities with the Laboratory Representative. If it is impossible to schedule any required services interruptions during normal working hours, it shall be required that the work be planned so that the existing system shutdown and final connections will be accomplished on an overtime basis, for which appropriate compensation will be made.

6. TEMPORARY HEAT AND COLD WEATHER ENCLOSURES

This Subcontractor shall provide, at his own expense, any temporary heat and/or heating equipment required for his use. He shall provide and pay for fuel and attendants for temporary heating. The use of open type or oil pot salamanders is prohibited. All waste products of combustion-type heaters shall be directly vented to the exterior of a structure and/or temporary enclosure. The Subcontractor shall provide all enclosures required for protection of his work.

7. OTHER SUBCONTRACTORS

Other construction subcontractors may be engaged in work in the general area covered by the work under this contract. These other subcontractors may be working concurrently with this Subcontractor, and will have equal rights of access to the areas and of the Laboratory furnished facilities. This Subcontractor will be expected to cooperate with the others to best utilize the available areas roadways and facilities.

8. MAINTAINING SERVICE

The Subcontractor shall support, maintain in place and in operation, all service pipes, electric conduits and other services within the Argonne-West construction limits and restore all such services if damaged through the operations of this subcontract.

9. SAFE WORK PERMIT

The Subcontractor shall perform no work at the Argonne-West area without a Safe Work Permit issued by the Laboratory in conformance with Section II, Chapter I of the Health and Safety Manual published by the Laboratory. The Subcontractor shall obtain such permit by transmitting to the Contracting Officer, or his authorized representative, a written request for such permit, containing a reference to the subcontract, the date when the work will commence, and describing any special risks known to the Subcontractor.

10. HEALTH AND SAFETY INDOCTRINATION FOR SUBCONTRACTOR PERSONNEL

All Subcontractor personnel are required to receive formal Health and Safety indoctrination prior to working in the Argonne-West area. Records will be maintained by the Laboratory, and if the indoctrination of any employee is not current (valid for one year), he shall, upon notice given by the Laboratory, receive such further indoctrination as is deemed necessary.

Subcontractor personnel may receive Health and Safety indoctrination at 8:15 A.M. or 12:45 P.M. on any normal work day. An indoctrination period will normally require thirty (30) minutes time.

11. MATERIALS REMOVED

All salvagable materials removed by the Subcontractor shall remain the property of the Laboratory and shall be delivered to the designated

Laboratory Representative in such condition that re-use may be made of the materials to the greatest extent possible.

Waste materials and debris shall be removed as described in the General Conditions, Division I, of this subcontract.

12. CONTRACTOR'S SUPERVISION

The Subcontractor shall provide and keep on the work during its progress a competent full-time superintendent and necessary assistants, all subject to the Laboratory's approval. Said superintendent shall not be changed without consent of the Laboratory unless he proves to be unsatisfactory to the Subcontractor and/or ceases to be in his employ. Said superintendent shall represent the Subcontractor during his absence and all directions given to him shall be as binding as if given to the Subcontractor. Important directions shall be confirmed in writing to the Subcontractor. Other directions will be so confirmed upon written request in each case.

13. CONSTRUCTION LIMITS

The work area, material and equipment storage area, location of construction office and similar installation areas are established by the authorized Laboratory Representative. The Subcontractor shall be limited in his access to these areas to the most direct route from public and plant roads, shall be responsible for restricting the movement of his employees, watchmen, subcontractors and all associated personnel to the construction limits, and shall have no privileges of access beyond the established limits except as permitted for the installation of utilities and services, and as described in Section 4, SANITARY FACILITIES.

14. PROTECTION

A. The Subcontractor shall continuously protect all work under this Subcontract from damage and also protect the Laboratory's property from injury or loss arising in connection with this Subcontract. The Subcontractor shall make good at his own expense and without cost to the Laboratory any such damage, loss, or injury. Adequately protect adjacent property as provided by law and the subcontract documents. Provide and maintain all shoring, bracing, sheathing, lights and other facilities for protection as required by the Laboratory. Protect all walks, drives, pavements, buildings, ramps and all existing utilities.

B. The Subcontractor shall keep appropriate parts of the work free from ice, snow and water, as a part of this Subcontract and provide at all times proper protection against weather. This protection shall maintain work and fixtures free from injury or damage. He shall cover (in an approved manner) all work liable to be damaged whenever work is not in progress.

C. If low temperatures make it impossible to continue operations safely in spite of cold weather precautions, the Subcontractor shall cease work and so notify the Laboratory.

15. TEMPORARY STRUCTURES

A. Construction

The Subcontractor shall furnish at his own expense all temporary structures, utilities and services required for use as offices, warehouses, shops, etc. The location and type of any temporary structure shall be subject to approval of the Laboratory before construction. Minimum acceptable requirements for temporary structure standards are as follows:

1. Wiring: All wiring in temporary buildings and services to such buildings shall conform to the National Electric Code.

2. Heating: Approved types include steam, high-pressure oil furnaces, butane-fired heaters in buildings containing more than 500 square feet of area (gravity-fed space heaters in buildings of less than 500 square feet area), and approved portable heaters of Herman-Nelson type when located outside with heat duct to building. Use of wood and coal-burning space heaters is not permitted. Use of electrical heaters is not permitted except in accordance with the section on temporary power and upon specific approval by the Laboratory.

B. Fire Protection Requirements

1. Inside Buildings: One approved type fire extinguisher for Class A fires (ordinary combustible) shall be installed for each 2500 square feet of floor area as a minimum requirement. In buildings where special hazards exist, fire extinguishers (CO_2, Dry Chemical, etc.) of the type approved for the respective hazard shall be installed in addition to the Class A type.

2. Outside Storage Areas: Fire barrels with buckets are acceptable for protection of ordinary combustible materials.

3. General: Fire protection for the entire work area must be established and maintained to conform with AEC Fire Department requirements.

C. Use of Tarpaulins: All tarpaulins shall be of approved fire-resistant type treated to be equal to Federal Specification No. CCC-D-746, which requires that a 1/2" strip sample of the canvas subjected to a Bunsen-burner flame for twelve seconds shall show not more than 5/8" charring and that the sample does not continue to burn upon the removal of the flame.

16. STORAGE

A. All operations of the Subcontractors, including storage of materials, upon premises of the Laboratory shall be confined to the areas specified, approved and/or authorized by the Laboratory. All materials and equipment shall be stored so as to insure preservation of their quality and fitness for the work. Ferrous metals shall be stored in a manner which will prevent objectionable changes in original surface characteristics. All stored materials shall be arranged in an orderly manner for ease of identification and inspection. This Subcontractor's storage areas shall be maintained in a neat and orderly condition at all times, and shall be kept free of accumulation of trash and debris.

B. Oils, fuels, welding gas, and other flammables shall be stored in areas located away from operational or construction buildings; and shall further be stored in containers with dispensing devices that comply with fire-safety regulations at the National Reactor Testing Station.

17. DISPENSARY, FIRST-AID AND FIRE-PROTECTION FACILITIES

A. The Laboratory and the Atomic Energy Commission will maintain and operate the following services for the protection of life and property normal to an installation of this nature.

Dispensary service, including part-time services of a nurse, ambulance service, and professional fire-fighting service are available at Central Facilities. Without guaranteeing the adequacy thereof, or assuming any liability whatsoever in connection therewith, the Laboratory will permit the Subcontractor to use such facilities as may be available without charge.

B. First-aid supplies and equipment for each job shall be furnished by the Subcontractor, at his own expense, and shall be kept under the supervision of a responsible person. Records on all first-aid treatments shall be kept and forwarded to the Laboratory.

C. Fire-protection supplies and equipment for the job such as fire extinguishers, etc., shall be furnished by the Subcontractor, at his own expense. Periodic inspections will be made by the AEC Fire Department to determine the adequacy of the fire protection.

18. SAFETY AND FIRE PROTECTION

Pursuant to Terms and Conditions Article entitled "Safety, Health and Fire Protection", compliance with the following codes and standards shall be considered minimum requirements.

Safety Standards (American National Standards Institute) including Safety Code for Building Construction, ANSI A10.2.

National Fire Codes.

Uniform Building Code 1970 (International Conference of Building Officials).

Argonne-West Health and Safety Manual

Motor Carrier Safety Regulations (Interstate Commerce Commission).

Lists of Inspected Appliances, Equipment and Materials (Underwriters Laboratories, Inc.).

Occupational Safety and Health Act (OSHA) 29-CFR-17.

A. The Subcontractor shall remove construction debris from the work area prior to the end of each work day. All scrap and debris shall be removed in accordance with the established policy in the General Conditions.

B. A full-time fire watch shall be provided by the Subcontractor during all cutting, burning and welding operations; and for at least 30 minutes thereafter. All combustible materials in the immediate vicinity, or beneath the welding operation, shall be covered with asbestos blankets to reduce the fire hazard. Fire watch personnel shall be equipped with a 2 1/2-gallon capacity water-type fire extinguisher and an ABC dry-chemical fire extinguisher.

19. TEMPORARY ELECTRICAL POWER

A. Electrical power at 120 volts will be available at Building 778 from existing receptacles. This power is available free of charge.

B. The electrical power furnished by the Laboratory shall be handled economically by this Subcontractor, with all possible precautions being taken to avoid waste. Electrical power shall not be used as a means of providing temporary heat for construction purposes.

20. VERIFYING MEASUREMENTS, LOCATIONS, ETC.

A. Each Sub-subcontractor shall obtain all necessary measurements and details from the Subcontractor in order that his work may fit other branches of work. Each Sub-subcontractor shall further verify all measurements, grades, levels and conditions in order that his work shall fit that of other Subcontractors and properly engage with the work in place.

B. The Subcontractor shall avoid confliction of work between trades. The Subcontractor shall check working and shop drawings of all trades and inform the trades as to correct locations of other work in order to avoid interference.

21. GENERAL CUTTING AND PATCHING

The Subcontractor shall be responsible for all cutting and patching required for the work of all trades.

22. BID ALTERNATES

The Subcontractor shall furnish an alternate bid for the following item, identified as Alternate Number 1:

> In lieu of installing a Hypalon liner sheet for the entire lagoon, provide a Bentonite clay seal over the lagoon bottom, and Hypalon liner over the inside of the dikes only.

This alternate is further described on the drawing, and in Division VIII of these specifications.

The Subcontractor shall specify in his bid proposal the amount to be deducted, or added, to the base bid for Alternate No. 1.

EARTHWORK

FOR

ARGONNE-WEST

SANITARY SEWAGE TREATMENT EXPANSION

FACILITY NO. 779

1. GENERAL

The requirements of the "General Conditions" of the contract and of the "Special Conditions," Divisions I and II of these specifications, shall form a part of this division of these specifications.

2. SCOPE OF WORK

The work to be performed under this division of these specifications consists of furnishing all plant, labor, materials, equipment, supervision and services necessary to perform all operations in connection with excavation, backfilling, and earthwork for the construction of the Sanitary Sewage Treatment Expansion as shown on the drawings and as described hereinafter.

The work includes, but is not necessarily limited to, the following:

A. Excavation for the sewage lagoon, culverts, and turnout gates.

B. Performing all operations in connection with placing, shaping, grading, and compaction of the sewage lagoon dike.

C. Backfilling of all trenches and excavated areas where required.

D. Disposal of any casual water encountered in excavation or on the surface during construction, by pumps or other equipment as required.

E. Establishing and setting all lines, grades, and appropriate surveys of any other type.

All work under this section shall be performed in accordance with applicable sections of the State of Idaho, Department of Highways, Standard Specifications for Highway Construction, 1967 Edition, and Supplemental Specifications, 1974, hereinafter referred to as "Idaho Specifications," which shall be considered as a part of these specifications, except as modified herein. Where, in said Idaho Specifications, reference is made to the State of Idaho, any of its departments, officials, or representatives, it shall be considered to mean, for the purpose of this contract, the Laboratory and/or it's designated representatives. All reference to unit-price bid items shall be disregarded, and all work included in this contract shall be for the lump-sum price. Idaho Specifications are available for inspection at offices of the Department of Highways, State of Idaho, and at the ANL Site Engineering office at Argonne-West.

3. RELATED WORK INCLUDED UNDER OTHER DIVISIONS OF THESE SPECIFICATIONS

A. Lagoon Liner - Division VIII

B. Roadwork and Paving - Division IV

4. DEFINITIONS AND/OR APPLICABLE PUBLICATIONS

Moisture Density Relations of Soils	AASHO T 180
Field Determination of Density of Soils in Place	AASHO T 147

5. EXCAVATION

A. The Subcontractor shall be responsible for ascertaining the nature of the subsurface soil conditions from information obtained from log of exploratory holes shown on the drawing, and/or from information obtained from his own investigations. Excavation shall not be classified, and material of all types shall be removed as required by the drawings and these specifications at the contract lump-sum price and without additional payment. Prior to any excavation operations, the Subcontractor shall obtain a safe work permit from the Laboratory. All excavation of every description and of whatever substances encountered shall be performed to the depths indicated on the drawings or as otherwise specified. During excavation, material suitable for backfilling shall be piled in an orderly manner at a sufficient distance from the banks of the excavations to avoid overloading and to prevent slides or cave-ins. All excavated materials not required or not suitable for backfill shall be removed and wasted as indicated in the General Conditions. Special care must be taken to prevent damage to any existing utility line crossed by this work. Grading for drainage control shall be done as may be necessary to prevent surface water from flowing into trenches or other excavations, and any water accumulating therein shall be immediately removed. Sheeting and shoring shall be done as may be necessary for the protection of the work and for the safety of personnel. Unless otherwise indicated, excavation shall be by open cut except that short sections of a trench may be tunneled if, in the opinion of the Laboratory, the pipe can be safely and properly installed and backfill can be properly tamped in such tunnel sections. Excavation shall comprise and include the satisfactory removal and disposition of all materials excavated regardless of the nature of the materials encountered and which shall, therefore, be understood to include both rock excavation and common excavation when both classes are present. When rock is encountered, it shall be fragmented for excavation by mechanical means. Blasting will not be permitted.

B. Trenches shall be of the necessary width for proper laying of pipes or concrete. The banks of trenches shall slope as practicable. Care shall be taken not to over-excavate. Where the excavation is made below the elevations shown on the drawings, the Subcontractor may restore the trench bottom to the proper elevation by placing and compacting fill material to 85 percent of maximum density. The bottom of trenches shall be accurately graded to provide uniform bearing and support for each section of the pipe on undisturbed soil at every point along it's entire length, except for the portions of the pipe sections where it is necessary to excavate for pipe joints.

C. The width of the trench at and below the top of pipe shall be no more than 3' - 0". The trench above the top of pipe shall be as wide as necessary for sheeting and bracing and the proper performance of the work. The bottom of the trench shall be rounded so that at least the bottom quadrant of the pipe shall rest firmly on undisturbed soil for as nearly the full length of the barrel as proper jointing operations will permit. This part of the excavation shall be done manually.

6. CONSTRUCTION OF SEWAGE LAGOON AND DIKE

A. Construction of the lagoon and dike shall include the work of clearing, grubbing, removal of organic or undesirable material from the lagoon area, and preparation of dike foundations. Construction of the lagoon and dike shall also include all excavation, including rock excavation, hauling, placing and compacting of material within the lagoon area from borrow pits, and the watering and rolling of dike sections. Disposal areas for soil and rock waste material are located within one-half (1/2) mile of the work area and shall be neatly piled or spread as directed by the Laboratory.

B. Earth borrow (select fill) material as may be required may be obtained, free of charge, from borrow areas within one mile of the site as designated by the Laboratory. All necessary pit development, loading, hauling, and handling shall be the responsibility of this Subcontractor at his own expense. The Subcontractor is advised that the designated borrow areas do not have unlimited depth of usable overburden over the underlying bedrock. The Subcontractor, at his option and expense, may extend the designated borrow areas or may develop new borrow areas upon approval of the Laboratory.

C. Construction requirements for the lagoon and dike shall be in accordance to applicable Sections 201, 203, and 205, of Idaho Specifications. A minimum of six inches of soil cover, compacted to 95 percent density, shall be maintained over all lava rock throughout the lagoon bottom. All earth fill on top and slopes of lagoon dike, for a depth of one (1) foot, shall be compacted to 95 percent of maximum density. All other earth dike material shall be compacted to 90 percent of maximum density.

D. After completion of dike construction, and installation of the liner specified in Division VIII, one layer of hand-placed rip-rap (4" minimum size smooth stones) shall be installed over the liner, covering the entire inner slope of the lagoon dike. Stones shall be neatly and tightly placed to provide a uniforn finished slope.

E. Pit-run aggregate is available, free of charge, in it's natural ungraded and unprocessed state from the gravel pit located approximately 1.0 mile northeast of the Central Facilities Concrete Batch Plant. The Subcontractor may use this pit as a source of road embankment material, base course, or other pit-run aggregate; or he may, at his option, develop other pits, if necessary and if approved by the Laboratory. All necessary pit development, processing, loading and hauling for completion of the work under these specifications shall be the full responsibility of the Subcontractor. The Subcontractor shall not work in any immediate area that is presently being used, or has been stripped for use, by others.

7. BACKFILLING

The trenches shall not be backfilled until the systems as installed conform to the requirements specified in the divisions covering the installation of overflows, valves, and culverts. Except as otherwise specified for conditions of overdepths, trenches shall be backfilled to the ground surface with selected excavated material or other material that is suitable for the density of compaction as hereinafter specified. Existing base course materials disturbed by trenching operations shall be replaced in an acceptable manner with materials equal to the adjacent base course. Top surfaces of dikes and berms shall be finished with 4" of pit-run gravel.

A. Lower Portion of Trenches

Backfill material shall be deposited in 6-inch-maximum-thickness layers and compacted with suitable hand tamping to 95 percent of maximum density, or as hereinafter specified, until there is a cover of not less than 2 feet. The backfill material in this portion of the trench shall consist of select earth materials or other approved materials free from stones. Special care shall be taken not to damage the piping.

B. Remainder of Trenches

The remainder of the trench, except the top 4 inches shall be backfilled with material that is free of stones larger than six inches. Backfill material shall be deposited in layers not exceeding the 6" thickness, and each layer shall be compacted to 95% of maximum density.

C. Top 4 Inches of Backfill

All areas to be backfilled, except lagoon bottom and dike side-slopes, shall be brought up to grade by depositing and spreading a 4-inch-thick blanket of pit-run gravel having a maximum aggregate size of 2 inches.

8. COMPACTION CONTROL

a. The degree of compaction and density of backfill shall be determined and controlled in accordance with AASHO Standards as follows:

T 180,	Method A	- for determining moisture density relations of soils.
T 147		- for field determination of density of soil in place.

b. All tests for density of soils in place will be made by the Laboratory, it's representative, or an independent testing laboratory engaged by the Laboratory Tests will be made at such locations and elevations, and in such number, as determined by the Laboratory to be necessary to ascertain and/or control the quality of the Subcontractor's work. The Subcontractor shall notify the Laboratory at least 24 hours in advance of any backfilling operations he intends to perform, and he shall conduct his operations in such a manner as to facilitate making the tests.

C. Backfill improperly placed shall be removed to the depth required for proper compaction as directed by the Laboratory and then replaced and compacted as specified.

ROADWORK & PAVING

FOR

ARGONNE-WEST

SANITARY SEWAGE TREATMENT EXPANSION

FACILITY NO. 779

1. GENERAL

The requirements of the "General Conditions" of the contract and of the "Special Conditions", Divisions I and II of these specifications, shall form a part of this division of these specifications.

2. SCOPE OF WORK

The work under this section consists of furnishing all plant, supervision, labor, materials, equipment, supplies and incidentals necessary and required to perform all operations in connection with paving and roadway construction for this project. The work delineated on the drawing includes, but is not limited to, the following:

A. Subgrades and roadbeds

B. Surface treatment

C. Finish grading

All work under this section shall be performed in accordance with applicable sections of the State of Idaho, Department of Highways, Standard Specifications for Highway Construction, 1967 Edition, and Supplemental Specifications, of 1974, hereinafter referred to as "Idaho Specifications," which shall be considered as a part of these specifications, except as modified herein. Where, in said Idaho Specifications, reference is made to the State of Idaho, any of its departments, officials, or representatives, it shall be considered to mean, for the purpose of this contract, the Laboratory and/or its designated representatives. All reference to unit-price bid items shall be disregarded, and all work included in this contract shall be for the lump-sum price. Idaho Specifications are available for inspection at offices of the Department of Highways, State of Idaho, and at the ANL Site Engineering office at Argonne-West.

3. RELATED WORK INCLUDED UNDER OTHER DIVISIONS OF THIS SPECIFICATION

Earthwork - Division III

4. DEFINITIONS AND/OR APPLICABLE PUBLICATIONS

Moisture Density Relations of Soils	AASHO T 180
Field Determination of Density of Soils in Place	AASHO T 147

5. ROADWAY

A. General

Select base course and materials shall conform to Idaho Specifications, Sections 303 and 703, 2-1/2-inch maximum.

Crushed gravel for gravel surface course shall conform to Idaho Specifications, Sections 303 and 703, 3/4-inch maximum.

Asphaltic road materials shall conform to Idaho Specifications, Section 702.

Prime coat, seal coat and cover coat shall conform to the requirements of Idaho Specifications 402, 403 and 703.

Construction of the surface treatment shall conform to the requirements of Idaho Specifications, Section 404.

B. Subgrades and Roadbeds

Construction of embankment and subgrade shall include all hauling, placing and compacting of material within the roadway embankment section, and the grading, watering and rolling of subgrade and embankment sections.

Each borrow (select fill) material as may be required may be obtained, free of charge, from borrow areas within one mile of the site as designated by the Laboratory Representative. All necessary pit development, loading, hauling, and handling shall be the responsibility of this Subcontractor at his own expense.

Pit-run aggregate is available, free of charge, in its natural ungraded and unprocessed state from the gravel pit located approximately 1.0 mile northeast of the Central Facilities Concrete Batch Plant. The Subcontractor may use this pit as a source of road embankment material, base course, or other pit-run aggregate; or he may, at his option, develop other pits, if necessary and if approved by the Laboratory. All necessary pit development, processing, loading and hauling for completion of the work under these specifications shall be the full responsibility of the Sub-contractor. The Sub-contractor shall not work in any immediate area that is presently being used, or has been stripped for use, by others.

Gravel base material shall be placed and compacted in 4-inch layers, being properly compacted before placing subsequent materials. Compaction shall be class A, Section 205 of the Idaho Specifications,

except that the minimum compaction required shall be 95 percent maximum density at optimum moisture. While compacting the base course, the Subcontractor shall exercise initiative in the most economical utilization of watering. Any displacement of subgrade due to negligence in distribution of water in compaction of base course shall be removed or dried, processed and recompacted in subgrade before any further courses of gravel are applied. Water and rolling will be applied as required to meet the minimum compaction requirements of this subcontract.

C. Gravel Surface Course

The Subcontractor shall be responsible for making his own arrangements for furnishing the 3/4-inch maximum crushed gravel for the 2-inch surface course. The aggregate shall be produced from tough, durable sand and gravel or rock and shall be uniform in quality and gradation. The material shall show a loss of not more than 40 percent in the Los Angeles Abrasion Test.

The aggregate shall conform to the gradations shown in Section 703 of the Idaho Specifications.

The compaction requirement for all 3/4-inch maximum gravel surface or leveling courses shall be in accordance with Section 205 of the Idaho Specifications for class A compaction.

Before final placement and compaction of the surface course, water shall be applied to the material in amounts as required. The water shall be thoroughly mixed with the aggregate by processing until the mixture is uniform throughout. Any segregated material shall be removed or segregation corrected as directed. Cost of correcting segregation shall be born by the Subcontractor.

Watering and rolling shall be applied in the amounts as required to meet the minimum compaction requirements of this Subcontract and the Idaho Specifications.

Upon completion of any specific portion of completed 2-inch surface course requiring a subsequent surface treatment, the Subcontractor shall maintain the grade and state of compaction by means of additional watering and rolling as directed by the Laboratory until time of final acceptance of the work under this subcontract.

6. PAVING

A. Type "B" Surface Treatment

Prime coat shall be liquid asphaltic road material, MC-70, MC-250, or as determined by temperature and surface conditions in accordance

to the Subcontractor's recommendations and with the approval of the Laboratory. Application shall be at the rate of 0.40 gallons per square yard. The Laboratory may terminate all work if, in its opinion, the wind is blowing excessively hard to prevent good workmanship.

The seal-coat liquid asphaltic road material shall be MC-800 or 3000, as determined by temperature and surface conditions, and shall be applied at a rate of 0.30 gallons per square yard.

The cover coat aggregate shall conform to the Idaho Specifications for aggregate for cover coat material, and shall be applied at a rate of 30 pounds per square yard. It shall be the responsibility of the Subcontractor to make his own arrangements for providing the cover coat material.

B. Application of Surface Treatment

The surface to be primed prior to application of Type "B" surfacing shall be processed and shaped to the required grade and section and shall be free of all ruts, corrugations, segregated material or other irregularities, and watered and rolled to provide a uniformly compacted surface.

All areas to be primed must be inspected and approved by the Laboratory prior to the application of the prime coat.

The spread of asphaltic material shall be uniform in thickness throughout; and special precautions shall be taken to prevent the end sprays of the spray bar from feathering out, resulting in a thinner application at the edges of the spread. The distributor shall be equipped with hand spray and nozzle to be used in areas too small or inaccessible to use the distributor. Hand spray shall be capable of applying bituminous material uniformly and in the amounts specified.

A self-propelled, pneumatic-tired roller of an approved type, exerting tire pressure and having an effective rolling width and a power roller will be required for rolling the cover coat. A steel, flat-faced, self-propelled power roller weighing eight (8) to ten (10) tons will be required for finish rolling of the gravel course to be Type "B" surfaced.

7. TESTS

Compaction tests and other tests felt necessary by the Laboratory shall be arranged by and shall be the responsibility of the Laboratory. The Subcontractor shall cooperate with the Laboratory in scheduling and performing the tests. The number of tests required will be determined by the Laboratory. Any materials or work tested and found below the requirements of the specifications shall be replaced or reworked by the Subcontractor at no additional cost to the Laboratory.

CONCRETE

FOR

ARGONNE-WEST

SANITARY SEWAGE TREATMENT EXPANSION

FACILITY NO. 779

1. GENERAL

The requirements of the General Conditions of the contract and of the Special Conditions, Divisions I and II of these specifications, shall form a part of this division of these specifications.

2. SCOPE OF WORK

The work to be performed under this division of these specifications consists of furnishing all plant, labor, materials, equipment, supervision, and services necessary to perform all operations in connection with concrete work for the construction of the Sanitary Sewage Treatment Expansion project as shown on the drawings and as described hereinafter.

The work includes, but is not necessarily limited to, the following:

A. Furnish and install concrete supports for turnout gates.

B. Furnish and install concrete blocks for inlet deflector head.

C. Furnish and install concrete for encasement of fence posts and gate posts.

D. Embedment in concrete of any item, including those installed under other divisions of these specifications, e.g., anchor bolts, sleeves, etc.

3. WORK INCLUDED UNDER OTHER DIVISIONS OF THESE SPECIFICATIONS

A.	Earthwork	Division III
B.	Fencing and Gates	Division VI
C.	Culverts and Turnout Gates	Division VII

4. GENERAL REQUIREMENTS

All concrete work shall be carried out with the use of an adequate number of workmen, proper and sufficient equipment, and under careful procedures, and in accord with applicable sections of the American Concrete Institute

"Building Code Requirements for Reinforced Concrete," ACI 318. All concrete shall be furnished in accord with the requirements of ASTM C-94. In the case of improperly placed concrete or poor concrete work, its removal and replacement shall be required at the expense of the Subcontractor.

5. MATERIALS

The concrete used for all work shall develop 3000 psi at 28 days strength, using the following materials:

A. Type I Portland Cement - Low alkali.

B. Fine Aggregate - Clean, hard sand, conforming to ASTM C-33-64.

C. Coarse Aggregate - Crushed stone or gravel, conforming to ASTM C-33.

D. Water - Potable.

E. Admixtures - Air entrainment to obtain 4 to 6 per cent by volume Vinsol resin or Darex.

6. PROPORTIONING

A. The maximum allowable water content shall be 5.25 gallons per sack of cement.

B. The minimum cement content shall be 5.0 sacks per cubic yard.

7. CURING AND PROTECTION

A. Protect all concrete surfaces from drying out. Wet curing of concrete shall begin as soon as possible without marring the surface of the work. Horizontal surfaces shall be covered with a cover such as burlap, kraft paper, or plastic, and shall be kept wet. Vertical forms shall be left in place and kept sufficiently wet at all times to prevent opening at the joints and the drying of concrete. Wet curing shall be continued for seven (7) days with Type I cement.

B. If approved by the Laboratory, membrane curing may be used as an alternate to wet curing specified above. The membrane curing shall conform to ASTM Designation C-309, Type I. Concrete shall be in moist condition when curing compound is applied. If forms are removed, a protective cover shall be placed on horizontal and vertical surfaces.

C. Protect fresh concrete from rain and the elements by an approved protective covering at all times.

D. Concrete shall not be placed when the temperature is, or is predicted to be within three (3) days, below 40°F., unless proper provisions have been made to maintain the following conditions:

(1) Concrete shall be heated to a minimum temperature of 50°F. and a maximum of 70°F.

(2) Form temperatures of 50°F. shall be maintained for a minimum of five (5) days for Type I concrete.

E. During hot weather, all surfaces shall be protected from direct sunlight for a minimum period of 48 hours when the air temperature is expected to exceed 90°F. within two (2) days after placement. Maximum concrete temperature shall not exceed 80°F. when mixing and placing.

F. Concrete shall be protected by a windbreaker or other suitable device to prevent dust, dirt, etc., from contaminating the surfaces of fresh or green concrete, or to prevent crazing of the surfaces.

8. FORM WORK

The Contractor shall provide all necessary form work and carpentry in connection with the concrete placement.

9. CONCRETE FINISHES

Finished concrete surfaces shall be in a true plane. Do not float or trowel excessively while concrete is still soft. After screeding, allow concrete to become stiff before troweling.

10. TESTING OR CONCRETE

The Laboratory reserves the right to have the concrete tested for strength, in accord with ASTM C31 and C39, for slump, and for materials, in accord with ASTM C231-62, if felt necessary by the authorized Laboratory Representative. Any defective work or work not in accordance with these specifications shall be removed and replaced at no cost to the Laboratory.

FENCING AND GATES

FOR

ARGONNE-WEST

SANITARY SEWAGE TREATMENT EXPANSION

FACILITY NO. 779

1. GENERAL

The requirements of the "General Conditions" of the contract and of the "Special Conditions," Divisions I and II of these specifications, shall form a part of this division of these specifications.

2. SCOPE OF WORK

The work under this section of these specifications consists of furnishing all supervision, labor, materials, equipment supplies and incidentals necessary and required to perform all operations in connection with the installation of a stock fence and gates for the Sanitary Sewage Treatment Expansion project, as shown on the drawings and as hereinafter specified.

The work includes, but is not necessarily limited to, the following:

A. Furnish and install a 3'-9" high steel stock fence and barbed wire.

B. Furnish and install two 14'-9" steel gates.

3. RELATED WORK INCLUDED UNDER OTHER DIVISIONS

Earthwork	Division III
Concrete Work	Division V

4. MATERIALS

A. Barbed Wire

The barbed wire shall be galvanized, 12½-gauge, copper-bearing steel, with 14-gauge, 2-point barbs, 5 inches apart, similar to Red Brand No. 80, as manufactured by Keystone Consolidated Industries, Inc.

B. Stock and Field Fence

The fabric for stock and field fence shall be galvanized copper-bearing steel, 39 inches high with nine 9-gauge line wires, graduating from three inches apart to the bottom to seven inches apart at the top. The vertical stay wires shall be 11-gauge, spaced at 6 inches apart. The fabric shall be similar to Red Brand, style number 939-6-11.

C. Line Fence Posts

Fence posts, except corner posts, shall be 7 feet long, studded-tee type, high-strength steel posts, with anchor plates and baked-enamel finish. Posts shall be furnished with five fasteners per post, for attaching barbed wire and stock fence.

D. Corner Fence Posts and Braces

Corner posts and braces shall be galvanized steel angles, of the sizes and lengths shown on the drawing. Steel members shall conform to ASTM Specification A-36.

E. Gate Posts

The gate posts shall be Schedule 40, galvanized steel pipe, conforming to ASTM Specification A-120, of the sizes and lengths shown on the drawing.

F. Gates

The gates shall be galvanized steel, single-swing, 5-panel, 52-inch-high by 14-foot-wide Life-Time model, as supplied by Morrison-Merrill and Company, Idaho Falls, Idaho, or approved equal. Gate shall be of the type shown on the drawings and shall be complete with bracing and manufacturer's standard gate hardware.

5. INSTALLATION

Corner posts, gate posts, braces, and the first adjacent line posts in each direction shall be encased in concrete footings of the size, shape, and depth shown on the drawing.

Line posts shall be driven to an approximate depth of two feet, keeping the post-tops in a line of gradual elevation change where necessary. Horizontal alignment shall be maintained between corner posts.

Stock fence fabric and barbed wire shall be properly stretched and fastened to posts with standard fasteners at line posts, and 11-gauge galvanized steel wire at corner posts and braces. Stock fence shall be fastened four places at each post, and barbed wire shall be fastened at each post.

CULVERTS AND TURNOUT GATES

FOR

ARGONNE-WEST

SANITARY SEWAGE TREATMENT EXPANSION

FACILITY NO. 779

1. GENERAL

The requirements of the General Conditions of the contract and of the Special Conditions, Divisions I and II of these specifications, shall form a part of this division of these specifications.

2. SCOPE OF WORK

The work covered by this division consists of furnishing all supervision, plant, labor, materials, equipment, supplies and incidentals necessary and required to perform all operations in connection with culverts, turnout gates, and miscellaneous metalwork, complete and acceptable, in conformance with this specification and the applicable drawing. The work includes, but is not necessarily limited to, the following:

A. Furnish and install overflow culverts, complete with turnout gate valves, within the sewage lagoon dikes.

B. Furnish and install inlet deflector at Lagoon No. 1 inlet pipe.

3. RELATED WORK INCLUDED UNDER OTHER DIVISIONS

Earthwork	-	Division III
Concrete Work	-	Division V

4. MATERIALS

A. Plain corrugated metal pipe culverts shall be eight-inch diameter, 16 gauge galvanized steel, conforming to AASHO Specification M-36.

B. Turnout gate valves shall be eight-inch diameter, ARMCO Model 101C spigot back slide gate, complete with 8-feet high support frame, all accessories, attachments, fasteners, and mastic.

C. Plain corrugated metal pipe for standpipes shall be 36-inch diameter, 16 gauge galvanized steel, conforming to AASHO Specification M-36.

D. Inlet deflector shall be fabricated as detailed on the drawing from steel plate conforming to ASTM Specification A36.

5. INSTALLATION

The corrugated metal pipe shall be carefully bedded in a soil foundation that has been accurately shaped and rounded to conform to the lowest

1/4 of the outside portion of circular pipe. Only undamaged pipe shall be laid. No pipe culvert shall be placed until the foundation has been approved. All pipes shall be laid with ends true to line and grade. The Subcontractor will be responsible for providing adequate cover over pipes during construction to protect them from damage.

The installation of culvert pipe in trenches shall be inspected by the Laboratory and approved prior to backfilling operations. Such approval shall not release the Subcontractor from his responsibility to provide an acceptable and undamaged installation at the time of final acceptance.

6. SUBMITTALS

The Subcontractor shall submit the following items of information to the Laboratory for approval and/or record file in accordance with Division I:

Shop drawings for Turnout Gate Valves.

SEWAGE LAGOON LINER

FOR

ARGONNE-WEST

SANITARY SEWAGE TREATMENT EXPANSION

FACILITY NO. 779

1. GENERAL

The requirements of the "General Conditions" of the contract and of the "Special Conditions", Divisions I and II of these specifications, shall form a part of this division of these specifications.

2. SCOPE OF WORK

The work under this section of these specifications consists of furnishing all supervision, labor, materials, equipment, supplies and incidentals necessary and required to perform all operations in connection with the installation of an impervious liner in the bottom and sloped sides of the new sewage lagoon. The work includes, but is not necessarily limited to, the furnishing and installing of the following:

A. Preparation of the excavated lagoon to receive the liner.

B. Installation of the liner.

C. Seaming joints to seal the bottom and sides of the lagoon.

D. Securing outside edges of the liner to prevent shifting or movement.

3. CODES AND SPECIFICATIONS

The following documents are applicable to this division of the specifications:

A.	ASTM D 412	Liner Tensile Strength, Elongation
B.	ASTM D 573	Heat Resistance
C.	ASTM D 471	Resistance to Water
D.	ASTM D 746	Brittleness
E.	ASTM D 2136	Bending Strength
F.	ASTM D 1149	Exposure to Weathering

4. MATERIAL

The liner material shall be fabricated from high-quality unvulcanized elastomeric compound, DuPont "Hypalon" or approved equal. Sheet shall be smooth, free from pinholes and surface blemishes, and shall show no evidence of ply delamination. Thickness shall be 30 mils with 2 ply lamination. The following physical properties shall be met:

A. Tensile strength, ASTM D 412, 1000 psi, minimum

B. Elongation at break, ASTM D 412, 250%, minimum

C. Resistance to heat aging. Change in original properties after 14 days at 212°F, ASTM D 573, Elongation - 40%, maximum, tensile strength + 30%, maximum.

D. Resistance to water. Change in weight after immersion for
7 days @ 70°F - + 5%, maximum
14 days @ 120°F - + 10%, maximum, ASTM D 471.

E. Low temperature properties
Brittleness temperature ASTM D 746, - 45°F
Cold bend (1/8" mandrel) ASTM D 2136; no cracks at -30°F.

F. Resistance to ozone, condition after exposure to 300 pphm ozone in air for 400 hours at 140°F. (Sample under 20% strain)
ASTM D 1149; no cracks.

5. INSTALLATION

The installation of the liner must be accomplished by an experienced contractor in accordance with a written procedure approved by the Laboratory.

A. The bottom and side walls of the lagoon shall be prepared as previously specified in Division III of this specification. The liner installation must be coordinated with the earthwork to insure that all holes, rocks, stumps, clods and other debris have been removed from the bed and inside slopes of the lagoon and that the surface is suitable to receive the liner.

B. The liner material shall be unfolded in place. Do not stretch the liner but place it loosely to accommodate soil settling.

C. Field seaming of the liner shall be accomplished by overlapping panels and sealing with an approved adhesive, or by welding overlap with hot air heat welding equipment in accordance with the liner manufacturer's recommendations. A written procedure approved by the Laboratory shall be followed.

D. The edge of the liner shall be anchored as shown on drawing W7790-0103-DD-00 and in accordance with the liner manufacturer's recommendations.

6. SUBMITTALS

The Subcontractor shall submit the following information in accordance with the procedure specified in the "General Conditions" Division I:

A. Material certification.

B. Installation procedure.

7. ALTERNATE NO. 1

In lieu of installing the liner sheet specified above, the Subonctractor shall provide the following, if acceptable to the Laboratory:

A. Liner sheet, as specified above, shall be installed over the inside slopes of the lagoon dike only. Edges shall be anchored as detailed on the drawing.

B. Bentonite clay shall be provided over the entire lagoon bottom, including the bottom of the lower liner-sheet anchorage-trench. The Bentonite shall be evenly distributed at a rate of one-half pound (minimum) per square foot of surface area.

C. A two-inch thick layer of blow sand shall be installed over the Bentonite. The blow sand shall be evenly distributed over the entire area to provide a uniform finished surface.

Blow sand is available, free of charge, from borrow areas within three miles of the site as designated by the Laboratory. All necessary pit development, loading, hauling, and handling shall be the responsibility of this Subcontractor at his own expense. The Subcontractor is advised that the designated borrow areas do not have unlimited depth of usable overburden over the underlying bedrock. The Subcontractor, at his option and expense, may extend the designated borrow areas or may develop new borrow areas upon approval of the Laboratory.

MECHANICAL WORK

FOR

ARGONNE-WEST

SANITARY SEWAGE TREATMENT EXPANSION

FACILITY NO. 779

1. GENERAL

The requirements of the "General Conditions" of the contract and of the "Special Conditions", Divisions I and II of these specifications, shall form a part of this division of these specifications.

2. SCOPE OF WORK

The work under this section of these specifications consists of furnishing all supervision, labor, materials, equipment, supplies and incidentals necessary and required to perform all operations in connection with the mechanical work. The work includes, but is not necessarily limited to, the furnishing and installing of:

(1) One four-cylinder air compressor with pressure regulator and relief valve.

(2) Discharge piping, fittings and check valve between the air compressor discharge and the sanitary lift station #778 discharge piping.

3. CODES AND SPECIFICATIONS

The following documents are applicable to the extent indicated in this specification and/or on the drawings:

(1) American Society for Testing and Materials

ASTM A 53 - 73	Welded and Seamless Steel Pipe
ASTM A 181 - 68	Forged or Rolled Steel Pipe Flanges, Forges Fittings, and Valves and Parts for General Service
ASTM A 307 - 68	Low-Carbon Steel Externally and Internally Threaded Standard Fasteners

(2) American National Standards Institutes, Inc. (ANSI)

ANSI B 16:11-1966	Forged Steel Fittings, Socket-Welding and Threaded
ANSI B 31.1-1973	Code for Pressure Piping
ANSI B 31.1b-1973	Addendum

4. EQUIPMENT

The following equipment shall be furnished and installed as shown on Drawing W7790-0103-DD-00, Sheet 4:

(1) One Piston Compressor, 4 cylinder, Gast Manufacturing Corporation, Model 7LDE-10, with 1-1/2 H.P., 230 volt, 3 phase, explosion proof motor, 10 cfm maximum flow 7.5 cfm @ 50 psig, with four filters and safety relief valve on compressor.

(2) One Pressure Regulator, Gast Manufacturing Corporation, Model 2R 000 A.

(3) One Pressure Gauge, Gast Manufacturing Corporation, Model AF 583.

5. PIPING MATERIAL

Includes 1-inch compressor discharge pipe installed from the 3/8-inch compressor outlet port to the Sanitary Lift Station #778 pump discharge pipe.

(1) Pipe - Schedule 40, black, ASTM A-53, Grade A threaded for connection to equipment.

(2) Fittings - Forged steel fitting, threaded, ASTM A181, Grade 1, ANSI B16:11.

(3) Valve - Check Valve, 125 lb. WSP, brass or bronze body with screwed ends, horizontal swing check, brass or bronze disc, Crane No. 34, Walworth No. 406 or approved equal.

(4) Union - 300 lb., black iron, screwed, brass to iron seats, ASTM A-197.

6. PIPE INSTALLATION

(1) General

(a) Piping shall be arranged and installed as indicated on the drawings with exposed piping straight, and where possible, run parallel and at right angles to walls and the floor unless otherwise indicated on the drawings.

(b) Parallel lines shall be located and grouped in the same horizontal or vertical plane and as close as possible but with ample spacing for access to valves.

(c) Full lengths of pipe shall be used wherever possible. Short lengths of pipe with couplings will not be permitted.

(d) All pipe shall be cut to exact measurement to be installed without forcing and shall be reamed and cleaned to eliminate foreign matter.

(e) All changes in direction shall be made by using pipe fittings.

(2) Cleaning and Protection

Before construction of any line, care shall be taken that the interior surfaces of all piping, tubing, and components are thoroughly clear and free of foreign material. During progress of construction, ends of all piping and tubing shall be protected to prevent ingress of dirt, water, and foreign material.

(3) Screwed Joints

(a) Threads shall conform to requirements of ANSI B2.1.

(b) Threads shall be made up with teflon tape.

(4) Hangers and Supports

(a) All piping shall be supported as shown on the drawings or as specified herein. All necessary structural steel, hanger rods, turnbuckles, beam clamps, angle iron clamps, inserts, brackets, pipe straps, supports, and bracing shall be provided as shown or as required.

(b) All materials and construction methods shall be in accordance with the latest edition of the Code for Power Piping, ANSI B31.1.0.

(c) Each pipe shall be separately supported, except that where two or more pipes are installed at the same elevation they may be supported on a trapeze hanger.

(d) Hangers shall be secured to the masonry or poured concrete structures with self drill expansion shields or ANL-approved equal.

7. TESTS

(1) At such time as progress of construction will permit and when designated by the authorized Laboratory representative, all piping installed under this subcontract shall be inspected and pressure tested for leaks.

(2) All devices, gauges and instruments which might be damaged due to test pressure shall be removed or isolated.

(3) The compressor piping shall be charged at 10 psig and the system checked for leakage with a glycerine-soap distilled water solution. Any leaks shall be repaired and the system retested at 10 psig until all leaks are corrected. The system shall be thus soap-bubble tested again at 10 psig pressure increments until 60 psig is reached. The system shall be isolated at 60 psig and the pressure held for two hours without a loss in pressure other than that which might result from changes in the surrounding temperature, such pressure loss not to exceed 5 psig.

8. SUBMITTALS

The Subcontractor shall submit the following items of information in accordance with the procedure specified in the GENERAL CONDITIONS, Division I:

(1) Shop drawings and instruction manual for the air compressor.

(2) Descriptive data shall be submitted on the following:

(a) Pressure regulator

(b) Check valve

(c) Pressure gauge

ELECTRICAL WORK

FOR

ARGONNE-WEST

SANITARY SEWAGE TREATMENT EXPANSION

FACILITY NO. 779

1. GENERAL

The requirements of the "General Conditions" of the contract and of the "Special Conditions", Divisions I and II of these specifications, shall form a part of this division of these specifications.

2. SCOPE OF WORK

The work under this section of these specifications consists of furnishing all plant, supervision, labor, materials, equipment, supplies and incidentals necessary and required to perform all operations in connection with the electrical work. The work includes, but is not necessarily limited to the following:

(a) Furnish and install (1) 208-volt 3-phase combination motor starter in a nema type 7D (explosion proof) enclosure. Included in the installation will be the power and control circuits shown on Dwg. No. W7790-0103-DD-00.

(b) Furnish and install additional grounding as indicated on the drawing.

(c) Furnish and install one (1) three-phase, 15-amp. circuit breaker (G.E. type T.Q.) in the existing 208/120 V panel located in Building 778.

3. DEFINITIONS AND/OR APPLICABLE PUBLICATIONS

National Electrical CODE (1971)

National Electrical Manufacturer's Association (NEMA)

4. RELATED WORK SPECIFIED IN OTHER SECTIONS

Valves, piping, compressor, and other devices are specified in the MECHANICAL WORK section.

5. EQUIPMENT AND INSTALLATION

The Subcontractor shall furnish all electrical materials and equipment, as shown on the drawings and all other equipment and materials necessary to complete the entire installation. The construction area is a Class I, Division I, Group D hazardous area as defined in the National Electrical Code. Therefore, all installation shall be in accordance with Code criteria for all Class I, Division I, Group D area.

Electrical materials shall be new and approved by the Underwriters' Laboratories, Inc., wherever standards have been established by that agency. All materials shall be the standard products of manufacturers regularly engaged in the production of such equipment and shall be the manufacturer's latest standard design that complies with the specification requirements.

The installation work shall be performed by skilled electrical workmen under the direct supervision of the Subcontractor and shall be executed in a neat and workmanlike manner, in accordance with the requirements of the National Electrical Code for a Class I Division I Group D hazardous area. The drawings indicate the extent and general arrangement of the conduit and the wiring systems. If any departures from the drawings are deemed necessary by the Subcontractor, details of such departures and reasons therefor shall be submitted as soon as practicable to the Laboratory for approval. No such departures shall be made without the prior written approval of the authorized Laboratory representative.

(a) Conduit

All conduit to be installed shall be rigid-steel, hot-dipped galvanized.

(b) Conduit Installation

Where installed in hazardous atmospheres, all conduit shall be galvanized rigid steel with threaded fittings. Short lengths of explosion-proof (Class I Group D) flexible metal conduit shall be used for making final raceway connections to motors and other vibrating equipment.

Conduit shall be installed complete with all accessories, fittings and boxes approved for Class I, Division I hazardous area. All work shall be run true, plumb, and parallel with adjacent members of the building, and shall present an orderly, neat, and workmanlike appearance. In addition to all other requirements for a heat and workmanlike installation, the following special requirements are mandatory for a Class I Group D hazardous area:

(1) Where conduit enters existing panels, sheet-metal junction boxes, outlet boxes, etc., it shall be solidly attached with double locknuts and bushings.

(2) Conduit shall be supported on each side of conduit bends or fittings with 1-hole conduit clamps and clamp backs.

(3) Manufactured elbows or field bends fabricated with the correct size of bending machine or hickey shall be used. Conduit bends that are crushed or deformed in any way shall not be installed.

(4) Conduit runs which have more than two 90° bends require a pull box; however, in cases of runs of conduit of 25 feet or less, it is possible that a conduit with three 90° bends can be pulled without the aid of a pull box. The Subcontractor shall be responsible for seeing that pull boxes are installed where they are needed, regardless of whether they are specifically shown on the drawings.

(5) Conduits entering an enclosure for switches, circuit breakers, fuses, relays, etc., shall be sealed according to the National Electrical Code for a Class I Division I hazardous area.

(c) Conduit Supports

One-hole conduit slamps shall be galvanized, malleable iron or steal straps with clamp backs of the correct size for the conduit being supported.

(d) Conductors

(1) Wire No. 8 AWG and larger shall be stranded copper with 600-volt, Type THW insulation, or approved equal.

(2) Control wire shall be No. 12 stranded copper with 600-volt, Type TW insulation as shown on the drawings.

(3) All phase and ground wire and cable No. 10 AWG size and smaller shall have factory color-coded conductors. This shall be extended to No. 4 AWG size and smaller for neutral wire and cable. Sizes larger than that above shall be factory color-coded or identified with "All temperature" color-coded markers. This marker identification shall include letters or numbers with color as listed below:

Service	Color
Phase A	Red
Phase B	Blue
Phase C	Black
Neutral	White
Ground	Green

(4) All control wiring, except where noted otherwise, shall be stranded and in the following color-coded insulation:

120-volt Circuits	Yellow

(5) Conductors having a green covering shall be used for grounding purposes only. All phase and neutral wire and cable shall be continuous in the same color-coded insulation and type to its extreme termination points.

(6) Where two or more circuits run to or through a single junction box and for all control wiring, each conductor shall be tagged with an approved marker identifying circuit, phase, or number. All feeders and mains shall be identified in pull boxes, wireways, and in wiring gutters of all panels to which they connect.

(7) Motor starter shall be connected so that when facing the circuit breakers or starters the phase conductor terminals shall be in the order A-B-C from left to right.

(e) Boxes

Pull and junction boxes shall be threaded for connection to conduit or cable terminations, and shall be explosion proof. Box sizes will not be less than the minimum size recommended by the National Electrical Code.

(f) Grounding

All electrical equipment shall be grounded as shown on the drawings.

6. TESTS

After installation is completed, and at such times as the Laboratory may direct, the Subcontractor shall conduct an operating test for approval. The test shall demonstrate that the system meets the operating requirements of the specifications, particularly the following:

(1) Individual conductors shall be free of grounds, shorts, and breaks. All conductors shall be given insulation resistance tests between adjacent conductors and to ground. The test shall be performed on completed circuits with all conductors connected and all enclosures grounded.

(2) No grounds shall exist between various items of equipment and their cabinets, enclosures, etc.

(3) All electrical circuits shall be checked for continuity after completion of wiring using an ohmmeter, and all complex circuitry, such as control circuits or other circuits consisting of several circuit elements, shall be checked for conformance with connection wiring diagrams.

(4) All electrical grounds shall be checked for continuity between the grounded equipment and siteground. Ground connections shall be visually examined and physically tested to assure firm attachment to equipment.

(5) All equipment shall be operated to demonstrate that all connections are properly made, that motor rotation is correct, that circuit protective devices are functioning, and that no circuits, motors, or other devices are overloaded.

(6) All elements of the electrical system shall be visually inspected to assure compliance with the circuit requirements, particularly, motor starter heater sizes, circuit breaker sizes, and other devices of similar nature.